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Research Paper

Safety Profile and Efficacy of Spinal Anaesthesia in Paediatric Age Group between 3 to 14 Years for Different Surgery.

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ABSTRACT

Background: *Though paediatric spinal anaesthesia has been used since early 20th century in developed countries even in neonates, still it is not common in our country. Spinal anaesthesia can be given in neonates and children for infraumbilical surgeries with an expert and experienced anaesthesiologist.*

Aim of the study:*The aim of the study was to evaluate the efficacy and safety of spinal anaesthesia in paediatric age group between 3 to 14 years for infraumblicus surgery in Bangladesh Shishu Hospital &Institute, Dhaka, Bangladesh.*

Methods:*This prospective case series analysis was done in Department of Anesthesiology, Bangladesh Shishu Hospital and Institute, Dhaka, Bangladesh within the period of 12 months from January 2022 to December 2022.*

Result:*Among 82 children, male and female were 73 (89.02%) and 9(10.98%), respectively. The mean (SD) age, body weight, ASA physical status I and II was 5.2 (2.1) years, 15.5 (4.8) kg, 60 (89.6%) and 7 (10.5%), respectively. The complications of spinal anaesthesia were hypotension 4 (4.88%), bradycardia 1 (1.22%), shivering 1 (1.22%), nausea and vomiting 1 (1.22%) and backache 1 (1.22%). The complications were minor and managed accordingly. There were no serious adverse events reported in any child. The mean (SD) operation time and recovery time from anaesthesia was 49.2 (8.4) minutes and 91.2 (9.2) minutes, respectively.*

Conclusion: *Spinal anaesthesia produces a reliable, profound and uniformly distributed block with rapid onset, good muscle relaxation, complete control of cardiovascular and stress responses compared with epidural or GA. There is also rapid recovery and minimal complications without special drugs or expensive equipments. However, greater acceptance and experience are still desired for this technique to become more popular.*

Keywords: *Spinal anaesthesia, Children,Paediatric spinal anaesthesia*

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I. INTRODUCTION

Spinal anaesthesia in paediatric population is in vogue for several years since it was first described in 1909 [1]. However, its utility in paediatric patients came down due to the introduction of various muscle relaxants and inhalational agents. In the 1980s, the technique of spinal anaesthesia became popular especially in expremature neonates and infants due to its advantage of overcoming postoperative apnoea risk by avoiding general anaesthesia [2]. In recent years, the subarachnoid block is considered a safe option to general anaesthesia in many lower abdominal and lower limb surgeries outside of the neonatal period. But it is still underutilised due to the fallacies regarding its consistency, feasibility, and safety of the procedure [3-6]. The dosage of local anesthesia in paediatric population is primarily based on body weight [6]. However, the body weight varies among children of same age-group. Hence, calculating intrathecal dose of anesthesia using body weight may lead to complications causing over or under-dosing. Thus, we thought of a formula using the age of the patient to calculate the intrathecal dose in children. Besides, the length of the spinal cord varies with age. Therefore, a hypothesis was made that age could be an appropriate parameter for calculating the dose for spinal anaesthesia in paediatrics and designed this particular study. The aim was to determine the efficacy of spinal anaesthesia in paediatric patients using 0.5% hyperbaric bupivacaine at a local anaesthetic volume calculated by age (age/5) in terms of the level of sensory blockade and adequacy of blockade for infra-umbilical surgeries [7].The aim of the study was to evaluate the efficacy and safety of spinal anaesthesia in paediatric age group between 3 to 14 years for infraumblicus surgery in Bangladesh Shishu Hospital & Institute, Dhaka, Bangladesh.

II. METHODOLOGY & MATERIALS

This prospective case series analysis was done in Department of Anesthesiology, Bangladesh Shishu Hospital and Institute, Dhaka, Bangladesh within the period of 12 months from January 2022 to December 2022. The study was conducted on total 82 patients. Inclusion criteria were: age- 2 years to 10 years, gender- both male and female, Ameri- can Society of Anaesthesiologists (ASA) physical status I and II, patients scheduled for elective surgery below umbilicus, parents gave consent for spinal anesthesia, and expected duration of surgery around 60 to 90 minutes.Exclusion criteria were: parental refusal, coagulation abnormalities, local infection at the spinal puncture site, neurological abnormalities such as spina bifida, increased intracranial pressure, uncorrected hypovolemia, and allergy or hypersensitivity to local anesthetic drugs.

All children were fasted 6 hours for solid food, 4 hours for liquid food and 2 hours for clear fluids before operation. An intravenous line was established with 20 or 22 gauge cannula in the operation theatre. A loading dose of injection ketamine 1 mg/kg body weight was given intravenously over 60 seconds. Injection midazolam 0.1 mg/kg body weight was given intravenously to prevent agitation and nightmares. The maintenance of spontaneous respiration was verified and oxygen was supplemented via facemask. Baseline vital parameter; pulse oximetry (SpO2), heart rate, ECG, mean arterial blood pressure (MAP) were recorded. Patients were positioned in lateral position without flexing neck, taking care of airway. The lumbo-sacral region was scrubbed with antiseptic solution of povidone iodine solution and then draped with sterile towels. Lumber puncture was performed with 27 gauge Quincke spinal needle at L4-L5 or L5-S1 interspace. After free reflux of cerebrospinal fluid (CSF) 0.5% bupivacaine (hyperbaric) 0.2 mg/kg to 0.4 mg/kg body weight was injected slowly over 30 seconds into the subarachnoid space. The spinal needle was then slowly withdrawn. Punctured area was covered with sterile gauze and then patient was put in the supine position. The efficacy of the sensory block was assessed with response to pin prick and motor block in the flaccid paralysis of lower extremities (unable to move hip, knees and foot). After establishment of the block the required surgery was allowed to perform. The patient's vital parameters; heart rate, respiratory rate, noninvasive blood pressure particularly MAP, SpO2 and ECG were monitored peroperatively at 5 minutes intervals throughout the operation. Assessment of level of sedation was monitored by using Ramsay Sedation Scale (RSS)[8]. Additional incremental doses of ketamine were administered slowly in aliquots till RSS reached 5. For maintenance and replacement of fluid, 5% dextrose in 0.45% normal saline was administered intravenously. Room temperature was maintained at 24-26°C. Preparation for general anaesthesia, airway equipments and emergency resuscitation drugs were ready in Operation Theater to combat any adverse event. Immediate complications of spinal anesthesia were observed, recorded and managed accordingly. The operational definitions were: hypotension- decrease in MAP more than 20% from baseline, bradycardia- decrease in heart rate less than 15% from baseline, desaturation- SpO2 below 93%, high spinal- defined as motor block of the upper limbs, no response to hand pinch. Side effects of ketamine sedation like transient apnoea (cessation of respiration more than 15 seconds), SpO2 less than 93%, laryngospasm, stridor and agitation were observed, recorded and managed. After completion of surgery, patients were transferred to recovery room and their vital signs were monitored, till the block regressed. Recovery status was assessed by Aldrete Recovery Score (ARS)[9]. Patients were considered ready to be discharged from recovery room when they had stable vital signs, oriented, had no intractable nausea or vomiting, had minimum pain, and ARS is persistently at least 8 or more than 8. Recovery time was calculated as the time from the last dose of medication given until discharge criteria were met. The children were then transferred to ward, where fluid maintenance continued until oral food allowed, children were allowed to feed as soon as possible, provided there were no surgical restrictions. Patients were followed postoperatively in the ward to evaluate late complication of spinal anaesthesia like postdural puncture headache (PDPH), transient neurological symptoms, meningitis, meningism, backache and urinaryretention. Results were reported using descriptive statistics (Microsoft Excel; Microsoft Corporation) and expressed as mean (SD) or percentage (%) where appropriate.

III. RESULT

Patient's characteristics are presented in Table 1. Among 82 children, male and female were 73 (89.02%) and 9(10.98%), respectively. The mean (SD) age, body weight, ASA physical status I and II was 5.2 (2.1) years, 15.5 (4.8) kg, 60 (89.6%) and 7 (10.5%), respectively. Different types of surgical procedures are presented in Table 2. Types of surgery were inguinal hernia repair 33 (40.24%), circumcision 21 (25.61%), appendicectomy 12(14.%), rectal polypectomy 6 (8.54%), hypospadius repair 5 (6.10%) and orchidopexy 4 (4.88%). Haemodynamic parameters of the children were shown in Table 3. Haemodynamic parameters of the patients were almost stable in all cases. The incidences of side effects of sedation were shown in figure 1. The incidences of side effects of sedation were: transient apnoea 2 (2.44%), desaturation ($SpO2<93\%$) 4 (4.88%), stridor 1 (1.22%), laryngospasm 1 (1.22%) and agitation 5(6.0%). Side effects were transient, self-limiting and managed conservatively. Complications of spinal anaesthesiawere shown in Table 4. The complications of spinal anaesthesia were hypotension 4 (4.88%), bradycardia 1 (1.22%), shivering 1 (1.22%), nausea and vomiting 1 (1.22%) and backache 1 (1.22%). The complications were minor and managed accordingly. There were no serious adverse events reported in any child. The duration of operation time and recovery time is shown in Table 5. The mean (SD) operation time and recovery time from anaesthesia was 49.2 (8.4) minutes and 91.2 (9.2) minutes, respectively.

Table 1. Characteristics of the patients (N=82)

Characteristics	Number	%
Gender		
Male	73	89.02
Female	9	10.98
American Society of Anaesthesiologistsphysical status		
I	76	92.68
II	6	7.32
Age in years, mean (SD)	5.2 (2.1)	
Body weight in kg, mean (SD)	15.5 (4.8)	

Table 2. Types of surgery (N=82)

Surgery	Number	%
Inguinal hernia repair	33	40.24
Circumcisions	21	25.61
Appendicectomy	12	14.63
Rectal polypectomy	7	8.54
Hypospadias repair	5	6.10
Orchidopexy	4	4.88

Table 3. Haemodynamic changes in patients (N = 82)

Reading time	Mean arterial pressure	Heart rate
	Mean (SD)	Mean (SD)
Baseline reading	64.9 (4.3)	96.7 (5.2)
Immediately after spinal anaesthesia	63.5 (5.2)	98.3 (5.8)
10 minutes after spinal anaesthesia	62.4 (4.1)	94.5 (4.2)
20 minutes after spinal anaesthesia	61.8 (4.0)	93.6 (3.4)
30 minutes after spinal anaesthesia	61.6 (3.7)	92.4 (3.0)
40 minutes after spinal anaesthesia	62.1 (3.5)	91.6 (2.8)
50 minutes after spinal anaesthesia	61.1 (3.5)	91.1 (2.7)

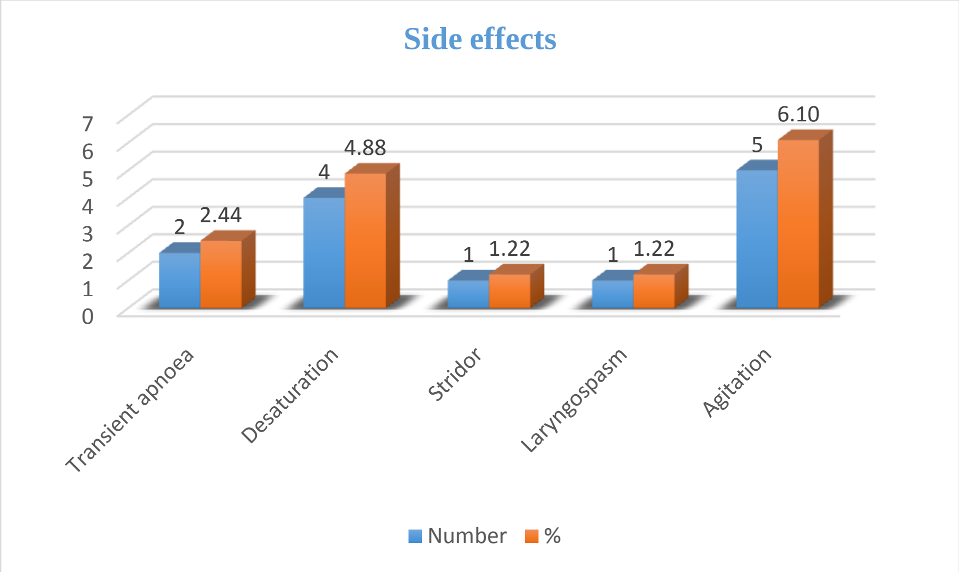

Figure-1: Side effects of sedation in patients (N = 82)

Table 4. Incidences of complications of spinal anaesthesia in patients (N = 82)

Type of complications	Number	%
Hypotension	4	4.88
Bradycardia	1	1.22
Shivering	1	1.22
Nausea, vomiting and retching	3	3.66
High spinal anaesthesia	0	0.00
PDPH	0	0.00
Backache	1	1.22
Meningism	0	0.00
Transient neurological symptoms	0	0.00
Meningitis	0	0.00
Urinary retention	0	0.00

Table 5. Duration of operation time and recovery time in patients (N = 82)

Characteristics	Values mean (SD)
Duration of surgical procedure, minutes	49.2 (8.4)
Recovery time, minutes	91.2 (9.2)

IV. DISCUSSION

There are important anatomic differences between children and adults, which are related to the child's development stage which should be considered at performing spinal anesthesia in children. Neonates spinal cord extends at the level of the third lumbar vertebra and, at the end of the first year of life reaches the location seen in adults, at the first lumbar vertebra.[10,11]Lumbar puncture in this age group must be performed below the 4th or 5th lumbar vertebrae (L4-L5 or L5-S1 interspace), for additional safety due to the risk of reaching the spinal cord with the needle.[12-14]. In this study spinal block was performed either L4-L5 or L5-S1 interspace. Cardiovascular changes related to spinal anaesthesia are less common in children than in adults. In children under 5 years of age, minimal changes in heart rate and blood pressure have been reported[.15,16]. In older patients (>8 years old), the sympathetic block can induce bradycardia or hypotension. In this study patients were hemodynamically stable in almost cases. Hemodynamic suppression following spinal anaesthesia is absent in children due to a smaller peripheral blood pool, immature sympathetic autonomic system, and compensatory reduction in vagal efferent activity.[17] Hence, preloading before spinal anaesthesia is not a routine in children.[18]. Performing spinal puncture in a struggling, agitated child may injure delicate neurovascular structures and should be avoided. Most children require additional sedation (ketamine, midazolam, thiopentone, propofol, halothane, sevoflurane or nitrous oxide)[19,20]. In this study, sedation regimen with ketamine and midazolam provided optimal conditions for spinal anaesthesia represented success rate 100%. General anaesthesia regarded to be safe, but the risk of post-operativeapnoea and hypoxemia is not negligible in infants who are born preterm and operated upon before post conceptual age of 46 weeks.[21,22] The rate of apnoea in this study was very low, short apnoea after induction of sedation required short time bag-valve-mask ventilation until spontaneous respiration regained. The specific dangers of airway compromise are suggested to be less with ketamine[.24,24] Incidences of desaturation (SpO2year study of 24409 regional blocks in children by the French-Language Society of Pediatric Anesthesiologists, the largest known study on complications, revealed a complication rate of 1.5 per 1000 in the 60% of children receiving central neuraxial blocks. The mean (SD) recovery time from anaesthesia was 91.2 (9.2) minutes. Spinal anaesthesia under sedation with ketamine is safe and effective technique for paediatricinfraumbilical surgery but it delays recovery when used with short acting benzodiazepines like midazolam.

Limitations of the study:

A limitation of this study was that we could not measure end tidal carbon dioxide (EtCO2). For measurement of EtCO2, special sensor containing facemask is required.

V. CONCLUSION AND RECOMMENDATIONS

Spinal anaesthesia produces a reliable, profound and uniformly distributed sensory block with rapid onset and good muscle relaxation. It results in more complete control of cardiovascular and stress responses than epidural or opioid anaesthesia. The failure rate of spinal anaesthesia was low in our study. Owing to high success rate (96.1%) and very low complication rates, our study breaks the misconception regarding the feasibility and safety of paediatric spinal anaesthesia. From our study we can recommend that spinal anaesthesia is ideal, safe and cost-effective for day-case surgeries and there is no additional requirement of any special drugs or equipments for the procedure. Because of these benefits, spinal anaesthesia can be preferred for children undergoing surgery in the lower part of the body. However, further studies with larger sample size are recommended.

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